

Remarks

Claims 1, 3-7, and 9-35 are pending, with claim 1 being independent. Claims 2 and 8 have been cancelled without prejudice to or disclaimer of the subject matter claimed therein. Claim 1 has been amended to even more clearly recite and distinctly claim the present invention. Claim 1 now incorporates the subject matter of original dependent claims 2 and 8. Applicants respectfully submit that no new matter has been added.

Applicants respectfully request the Examiner to withdraw the outstanding rejections in view of the foregoing amendments and the following remarks.

Specification

The Specification is objected to because of informalities. It is asserted that the Abstract is more than a paragraph in length. It is also asserted that the specification is missing section headings and a Brief Description of the Drawings. Applicants note the Preliminary Amendment filed with the application on 20 December 2004. In the Preliminary Amendment the specification was amended. In particular, the Abstract was replaced with an Abstract one paragraph in length. Section Headings were inserted at the appropriate locations. A Brief Description of the Drawing was also included. Applicants request that the Preliminary Amendment be considered and in view thereof, this objection be withdrawn.

Claim Rejections under 35 U.S.C. § 102(b)

Claims 1, 3-6, 9-13, 18, 20-22, 26, 31, and 35 are rejected under 35 U.S.C. 102(b) as allegedly being anticipated by Callahan (US 2002/0010261). Applicants respectfully disagree with this rejection; therefore, this rejection is traversed.

As noted above, claim 1 has been amended to even more clearly recite and distinctly claim the present invention and claim 1 now incorporates the subject matter of original dependent claims 2 and 8.

Callahan relates to a polymer matrix material including a polymerization product of one or more monomers. The polymer matrix material of Callahan is suitable for supporting a liquid solution, particularly a solution containing an ionic species to constitute an acid or basic electrolyte. Callahan discloses that a *water soluble or water swellable polymer acts as*

a reinforcing element and may comprise polysulfone, poly(sodium-4-styrenesulfonate), carboxymethyl cellulose, sodium salt of poly(styrenesulfonic acid-co-maleic acid), corn starch, any other water-soluble or water-swellaable polymers or combinations comprising at least one of the foregoing polymers. (paragraph [0064]).

In contrast, the presently claimed ionic conduction material comprises a polymer matrix, at least one ionic species, and at least one reinforcing agent, wherein the reinforcing agent is a cellulosic material comprised of cellulose single crystals or of cellulose microfibrils. Applicants note that the cellulosic material is comprised of cellulose single crystals or of cellulose microfibrils, which are highly crystalline and provide mechanical strength due to their physical properties. Callahan does not disclose or suggest the presently claimed reinforcing agent.

Moreover, Applicants respectfully submit that Callahan does not disclose or suggest including in the polymer matrix a non-solvating polymer carrying acidic ionic groups selected from the group consisting of alkylsulfonic groups, arylsulfonic groups, perfluorosulfonic groups, and perfluoro-carboxylic groups.

Accordingly, Applicants respectfully submit that Callahan does not disclose or suggest the presently claimed an ionic conduction material. For at least the above noted reasons, Applicants respectfully request withdrawal of this rejection.

Claim Rejections under 35 U.S.C. § 103(a)

Claims 2, 7, 8, 27, and 28 are rejected under 35 U.S.C. 103(a) as allegedly being unpatentable over Callahan in view of Fukutomi (EP 1031598). Applicants respectfully disagree with this rejection; therefore, this rejection is traversed.

The present invention relates to an ionic conduction material comprising a polymer matrix, at least one ionic species and at least one reinforcing agent, wherein:

- the polymer matrix is a solvating polymer optionally having a polar character, non-solvating polymer carrying acidic ionic groups selected from the group consisting of alkylsulfonic groups, arylsulfonic groups, perfluorosulfonic groups, and perfluoro-carboxylic groups, or a mixture of a solvating or non-solvating polymer and an aprotic polar liquid;

- the ionic species is either an ionic compound selected from salts and acids, said compound being in solution in the polymer matrix, or an anionic or cationic ionic group fixed by covalent bonding on the polymer, or a combination of the two;
- the reinforcing agent is a cellulosic material comprised of cellulose single crystals or of cellulose microfibrils.

The reinforcing agent of the present invention is a cellulosic material comprised of cellulose single crystals or of cellulose microfibrils. These materials are highly crystalline and provide mechanical strength due to their physical properties.

As described above, Callahan relates to a polymer matrix material including a polymerization product of one or more monomers, which is suitable for supporting a liquid solution, particularly a solution containing an ionic species to constitute an acid or basic electrolyte. Callahan discloses that the *water soluble or water swellable polymer acts as a reinforcing element* and may comprise as one option carboxymethyl cellulose. (paragraph [0064]).

It is noted that the carboxymethylcellulose (CMC), provided as an option as the reinforcing element of Callahan, is amorphous or weakly crystalline. As described above, the presently claimed cellulosic material is comprised of cellulose single crystals or of cellulose microfibrils which are highly crystalline and provide mechanical strength due to their physical properties. The amorphous or weakly crystalline carboxymethylcellulose of Callahan does not exhibit the mechanical strength of the presently claimed reinforcing agent. Moreover, Applicants respectfully submit that Callahan does not disclose or suggest including in the polymer matrix a non-solvating polymer carrying acidic ionic groups selected from the group consisting of alkylsulfonic groups, arylsulfonic groups, perfluorosulfonic groups, and perfluoro-carboxylic groups.

Fukutomi relates to an ion-selective membrane formed of an ion-selective membrane forming component and a woven-fabric-shaped backing. Fukutomi discloses that the woven-fabric-shaped backing has a meshed structure.

Applicants respectfully submit that Fukutomi does not disclose or suggest ***ionically conductive materials*** as presently claimed. In contrast, Fukutomi discloses selectively ***ion-permeable*** materials. Applicants respectfully submit that ionically conductive materials are significantly different than ion-permeable materials. An ionically conductive material, as

presently claimed, is a material that conducts ions. Accordingly, the nature of the material provides the mobility of the anions and cations, the mobility of the ionic species increasing when the degree of crystallinity and the glass transition temperature decrease. In contrast, the ion-selective material of Fukutomi is a film or sheet of a substance that is preferentially permeable to some species or types of ions. The ion-selective material does **not** conduct ions but allows selective permeation.

Moreover, Fukutomi discloses a *woven-fabric backing* having a meshed structure. Accordingly, the cellulosic material used in Fukutomi is in the form of a *woven sheet*. Applicants respectfully submit that a cellulosic material in the form of a woven sheet is significantly different than the presently claimed reinforcing agent, wherein the reinforcing agent is a cellulosic material comprised of cellulose single crystals or of cellulose microfibrils. Cellulose microfibrils are obtained from sugar beet pulp residues, food industry waste, by chemical and physical treatments as described by A. Dufresne et al. (Appl. Polym. Sci., 64, 1185-94, (1997)) (specification page 8, lines 11-15). Cellulose microfibrils are crystalline cellulosic compounds and as such, confer mechanical strength to the reinforcing agent.

Applicants respectfully submit that a woven micro-scale cellulose material is not in any way equivalent to the presently claimed cellulosic material comprised of cellulose single crystals or of cellulose microfibrils.

Therefore, even if combined Callahan and Fukutomi do not disclose the presently claimed ion conduction material. Even if combined, Callahan and Fukutomi do not disclose or suggest an ionic conduction material comprising a polymer matrix, at least one ionic species and at least one reinforcing agent, wherein:

- the polymer matrix is a solvating polymer optionally having a polar character, non-solvating polymer carrying acidic ionic groups selected from the group consisting of alkylsulfonic groups, arylsulfonic groups, perfluorosulfonic groups, and perfluoro-carboxylic groups, or a mixture of a solvating or non-solvating polymer and an aprotic polar liquid;
- the ionic species is either an ionic compound selected from salts and acids, said compound being in solution in the polymer matrix, or an anionic or cationic ionic group fixed by covalent bonding on the polymer, or a combination of the two;

- the reinforcing agent is a cellulosic material comprised of cellulose single crystals or of cellulose microfibrils.

For at least the above noted reasons, Applicants respectfully submit that claims 2, 7, 8, 27, and 28 are not obvious over Callahan in view of Fukutomi and Applicants respectfully request withdrawal of this rejection.

Claims 14-17, 19, and 32-34 are rejected under 35 U.S.C. 103(a) as allegedly being unpatentable over Callahan in view of Hirakawa (US 5,281,495). Applicants respectfully disagree with this rejection; therefore, this rejection is traversed.

As described above, Callahan relates to a polymer matrix material including a polymerization product of one or more monomers, which is suitable for supporting a liquid solution, particularly a solution containing an ionic species to constitute an acid or basic electrolyte. Callahan discloses that a *water soluble or water swellable polymer acts as a reinforcing element* and may comprise carboxymethyl cellulose.

Hirakawa discloses a rechargeable alkaline storage cell having a negative electrode, a positive electrode, and a separator disposed between the electrodes. Hirakawa is cited for disclosing electrodes comprising carbon as conductive material and the use of manganese as insertion material. Hirakawa does not disclose or suggest a reinforcing agent, wherein the reinforcing agent is a cellulosic material comprised of cellulose single crystals or of cellulose microfibrils.

As described in detail above, the carboxymethylcellulose (CMC) provided as an option as the reinforcing element of Callahan is amorphous or weakly crystalline. As described above, the presently claimed cellulosic material is comprised of cellulose single crystals or of cellulose microfibrils which are highly crystalline and provide mechanical strength due to their physical properties. The amorphous or weakly crystalline carboxymethylcellulose of Callahan does not exhibit the mechanical strength of the presently claimed reinforcing agent, wherein the reinforcing agent is a cellulosic material comprised of cellulose single crystals or of cellulose microfibrils. Moreover, Applicants respectfully submit that Callahan does not disclose or suggest including in the polymer matrix a non-solvating polymer carrying acidic ionic groups selected from the group consisting of

alkylsulfonic groups, arylsulfonic groups, perfluorosulfonic groups, and perfluoro-carboxylic groups.

Accordingly, Callahan does not disclose the presently claimed ion conduction material. Hirakawa as cited, and in its full disclosure, does not cure the many above-noted deficiencies in Callahan. Accordingly, even if combined, Callahan in view of Hirakawa do not disclose or suggest the presently claimed ionic conduction material.

Therefore, for at least the above noted reasons, Applicants respectfully request withdrawal of this rejection.

Claim 23 is rejected under 35 U.S.C. 103(a) as allegedly being unpatentable over Callahan in view of Nielsen (US 2002/0010261). Applicants respectfully disagree with this rejection; therefore, this rejection is traversed. Applicants note that claim 23 further defines the electrolyte for a lithium polymer battery.

As described above, Callahan relates to a polymer matrix material including a polymerization product of one or more monomers, which is suitable for supporting a liquid solution, particularly a solution containing an ionic species to constitute an acid or basic electrolyte. Callahan discloses that a *water soluble or water swellable polymer acts as a reinforcing element* and may comprise carboxymethyl cellulose.

Nielsen discloses an adhesive composition containing hydrocolloids in the form of discrete particles wherein the adhesive composition comprises a matrix comprising one or more amorphous poly- α -olefins.

The adhesive composition of Nielsen is a ***pressure sensitive adhesive suitable for application to human or animal skin***. Applicants respectfully submit that a pressure sensitive adhesive composition is in no way applicable to an ionic conduction material. Applicants respectfully submit that in no way is there suggestion or motivation to combine any aspect of the pressure sensitive adhesive composition suitable for application to skin of Nielsen with the polymer matrix material for supporting a liquid solution of Callahan.

Moreover, even if combined Callahan in view of Nielsen do not disclose the presently claimed ion conduction material.

As described in detail above with regard to Callahan, the carboxymethylcellulose (CMC) provided as an option as the reinforcing element of Callahan is amorphous or weakly crystalline. As described above, the presently claimed cellulosic material is comprised of cellulose single crystals or of cellulose microfibrils which are highly crystalline and provide mechanical strength due to their physical properties. The amorphous or weakly crystalline carboxymethylcellulose of Callahan does not exhibit the mechanical strength of the presently claimed reinforcing agent, wherein the reinforcing agent is a cellulosic material comprised of cellulose single crystals or of cellulose microfibrils. Moreover, Applicants respectfully submit that Callahan does not disclose or suggest including in the polymer matrix a non-solvating polymer carrying acidic ionic groups selected from the group consisting of alkylsulfonic groups, arylsulfonic groups, perfluorosulfonic groups, and perfluoro-carboxylic groups.

Accordingly, Callahan does not disclose the presently claimed ion conduction material. Even if combined, Nielsen as cited, and in its full disclosure, does not cure the many above-noted deficiencies in Callahan. Accordingly, even if combined, Callahan in view of Nielsen do not disclose or suggest the presently claimed ionic conduction material.

Therefore, for at least the above noted reasons, Applicants respectfully request withdrawal of this rejection.

Claims 24 and 25 are rejected under 35 U.S.C. 103(a) as allegedly being unpatentable over Callahan in view of Tossici (US 6,087,043). Applicants respectfully disagree with this rejection; therefore, this rejection is traversed.

As described above, Callahan relates to a polymer matrix material including a polymerization product of one or more monomers, which is suitable for supporting a liquid solution, particularly a solution containing an ionic species to constitute an acid or basic electrolyte. Callahan discloses that a *water soluble or water swellable polymer acts as a reinforcing element* and may comprise carboxymethyl cellulose.

Tossici discloses a lithium-ion rechargeable battery with carbon-based anode containing a lithium intercalating compound, a non-aqueous lithium ion-conducting electrolyte, and a carbon-based anode comprising KC_8 .

Tossici does not disclose or suggest that the anode also contain a reinforcing agent as presently claimed wherein the reinforcing agent is a cellulosic material comprised of cellulose single crystals or of cellulose microfibrils.

As described in detail above with regard to Callahan, the carboxymethylcellulose (CMC) provided as an option as the reinforcing element of Callahan is amorphous or weakly crystalline. As described above, the presently claimed cellulosic material is comprised of cellulose single crystals or of cellulose microfibrils which are highly crystalline and provide mechanical strength due to their physical properties. The amorphous or weakly crystalline carboxymethylcellulose of Callahan does not exhibit the mechanical strength of the presently claimed reinforcing agent, wherein the reinforcing agent is a cellulosic material comprised of cellulose single crystals or of cellulose microfibrils. Moreover, Applicants respectfully submit that Callahan does not disclose or suggest including in the polymer matrix a non-solvating polymer carrying acidic ionic groups selected from the group consisting of alkylsulfonic groups, arylsulfonic groups, perfluorosulfonic groups, and perfluoro-carboxylic groups.

Accordingly, Callahan does not disclose the presently claimed ion conduction material. Tossici as cited, and in its full disclosure, does not cure the many above-noted deficiencies in Callahan. Accordingly, even if combined, Callahan in view of Tossici do not disclose or suggest the presently claimed ionic conduction material.

Therefore, for at least the above noted reasons, Applicants respectfully request withdrawal of this rejection.

Claim 29 is rejected under 35 U.S.C. 103(a) as allegedly being unpatentable over Callahan in view of Skotheim (US 4,442,185). Applicants respectfully disagree with this rejection; therefore, this rejection is traversed.

As described above, Callahan relates to a polymer matrix material including a polymerization product of one or more monomers, which is suitable for supporting a liquid solution, particularly a solution containing an ionic species to constitute an acid or basic electrolyte. Callahan discloses that a *water soluble or water swellable polymer acts as a reinforcing element* and may comprise carboxymethyl cellulose. Skotheim relates to a photoelectric device. Skotheim is cited as disclosing a solar cell comprising a photoanode

and a cathode separated by electrolyte. Skotheim does not disclose or suggest a reinforcing agent, wherein the reinforcing agent is a cellulosic material comprised of cellulose single crystals or of cellulose microfibrils.

As described in detail above with regard to Callahan, the carboxymethylcellulose (CMC) provided as an option as the reinforcing element of Callahan is amorphous or weakly crystalline. As described above, the presently claimed cellulosic material is comprised of cellulose single crystals or of cellulose microfibrils which are highly crystalline and provide mechanical strength due to their physical properties. The amorphous or weakly crystalline carboxymethylcellulose of Callahan does not exhibit the mechanical strength of the presently claimed reinforcing agent, wherein the reinforcing agent is a cellulosic material comprised of cellulose single crystals or of cellulose microfibrils. Moreover, Applicants respectfully submit that Callahan does not disclose or suggest including in the polymer matrix a non-solvating polymer carrying acidic ionic groups selected from the group consisting of alkylsulfonic groups, arylsulfonic groups, perfluorosulfonic groups, and perfluoro-carboxylic groups.

Accordingly, Callahan does not disclose the presently claimed ion conduction material. Skotheim as cited, and in its full disclosure, does not cure the many above-noted deficiencies in Callahan. Accordingly, even if combined, Callahan in view of Skotheim do not disclose or suggest the presently claimed ionic conduction material.

Therefore, for at least the above noted reasons, Applicants respectfully request withdrawal of this rejection.

Claim 30 is rejected under 35 U.S.C. 103(a) as allegedly being unpatentable over Callahan in view of Niu (US 6,205,016). Applicants respectfully disagree with this rejection; therefore, this rejection is traversed.

As described above, Callahan relates to a polymer matrix material including a polymerization product of one or more monomers, which is suitable for supporting a liquid solution, particularly a solution containing an ionic species to constitute an acid or basic electrolyte. Callahan discloses that a *water soluble or water swellable polymer acts as a reinforcing element* and may comprise carboxymethyl cellulose.

Niu discloses composite electrodes for use in electrochemical capacitors. Niu is cited for disclosing a supercapacitor comprised of an electrochemical cell. Niu does not disclose or suggest a reinforcing agent, wherein the reinforcing agent is a cellulosic material comprised of cellulose single crystals or of cellulose microfibrils.

As described in detail above with regard to Callahan, the carboxymethylcellulose (CMC) provided as an option as the reinforcing element of Callahan is amorphous or weakly crystalline. As described above, the presently claimed cellulosic material is comprised of cellulose single crystals or of cellulose microfibrils which are highly crystalline and provide mechanical strength due to their physical properties. The amorphous or weakly crystalline carboxymethylcellulose of Callahan does not exhibit the mechanical strength of the presently claimed reinforcing agent, wherein the reinforcing agent is a cellulosic material comprised of cellulose single crystals or of cellulose microfibrils. Moreover, Applicants respectfully submit that Callahan does not disclose or suggest including in the polymer matrix a non-solvating polymer carrying acidic ionic groups selected from the group consisting of alkylsulfonic groups, arylsulfonic groups, perfluorosulfonic groups, and perfluoro-carboxylic groups.

Accordingly, Callahan does not disclose the presently claimed ion conduction material. Niu as cited, and in its full disclosure, does not cure the many above-noted deficiencies in Callahan. Accordingly, even if combined, Callahan in view of Niu do not disclose or suggest the presently claimed ionic conduction material.

Therefore, for at least the above noted reasons, Applicants respectfully request withdrawal of this rejection.

Conclusion

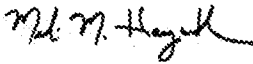
For at least the reasons noted above, the art of record does not disclose or suggest the inventive concept of the present claims.

In view of the foregoing amendments and remarks, reconsideration of the claims and allowance of the subject application is earnestly solicited. In the event that there are any questions relating to this response or the application, it would be appreciated if the Examiner would telephone the undersigned attorney.

If necessary for a timely response, this paper should be considered as a petition for an Extension of Time and please charge any deficiency in fees or credit any overpayments to Deposit Account No. 05-1323 (Docket # 103997.B130109).

Respectfully submitted,

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